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Comparison of Incidence of Tourniquet Pain with Ultrasound-guided Infraclavicular and Axillary Approach of Brachial Plexus Block in Adult Patients: A Randomized Controlled Trial

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ABSTRACT

Background and aim: Tourniquet pain is a common concern during upper-limb surgery under brachial plexus block. This study compared the incidence and severity of tourniquet pain following ultrasound-guided axillary (AX) and infraclavicular (IC) brachial plexus blocks.

Material and methods: In this prospective randomized controlled trial, 44 adults aged 18–60 years, classified as ASA I–III and undergoing upper-limb surgery requiring a tourniquet for more than 45 minutes, were randomized to receive ultrasound-guided AX or IC brachial plexus block. Both groups received 24 mL of local anesthetic. We assessed tourniquet pain using a visual analog scale (VAS). We also evaluated block characteristics, procedural time, adverse events, and patient and surgeon satisfaction.

Results: We analyzed 22 patients in the AX group and 21 in the IC group after one patient in the IC group experienced block failure. Tourniquet pain occurred in 6 patients (27.3%) in the AX group and 2 patients (9.5%) in the IC group, with no statistically significant difference ($p=0.240$; $RR=0.35$, 95% CI: 0.08–1.54). Four AX patients had mild pain, and two had moderate pain, while both IC patients had mild pain. Needling time ($p=0.006$) and total block performance time ($p=0.016$) were significantly longer with IC block. Other block characteristics, adverse events, and satisfaction scores were comparable.

Conclusions: We found no statistically significant difference in the incidence or severity of tourniquet pain between ultrasound-guided AX and IC brachial plexus blocks. IC block required a longer procedural time.

1. Introduction

Anaesthesiologists must select an appropriate brachial plexus block technique for upper limb surgeries requiring tourniquet application. Both infraclavicular (IC-BPB) and axillary (AX-BPB) approaches are commonly used for procedures involving the forearm and other regions distal to the elbow. The choice between these approaches may depend on several factors, including block effectiveness, procedural time, incidence of tourniquet pain, anaesthesiologist experience, and patient and surgeon satisfaction.^[1] Tourniquet pain remains an important clinical concern despite an otherwise successful brachial plexus block. Its underlying mechanism remains unclear, although evidence suggests that both cutaneous and deeper neural structures may contribute to perceived tourniquet-related pain. The musculocutaneous, radial, medial cutaneous brachial (MCBN), and intercostobrachial (ICBN) nerves have been implicated in this process. A successful MCBN blockade may be more likely with the infraclavicular approach because the brachial plexus cords generally remain clustered near the point proximal to the MCBN origin.^[1] In contrast, the ICBN is not routinely blocked by either the axillary

or infraclavicular approach.^[2] Pneumatic tourniquets are routinely used during orthopedic and plastic surgical procedures to provide a relatively bloodless operative field and improve surgical conditions. Nevertheless, patients may develop tourniquet-related pain despite adequate brachial plexus blockade, which may be accompanied by physiological responses such as tachycardia, hypertension, and diaphoresis. In some cases, additional analgesia may be required, and severe or inadequately controlled pain may interfere with the conduct of surgery or necessitate conversion to general anesthesia.^[3–5] Only a limited number of studies have directly compared infraclavicular and axillary brachial plexus blocks regarding tourniquet pain, and their findings have not been entirely consistent.^[1, 6] Differences in local anesthetic volume, block technique, single- or multiple-injection approaches, landmark versus ultrasound-guided techniques, operator experience, and outcome assessment methods may partly explain these discrepancies.^[1, 6] The present prospective randomized controlled trial was therefore designed to compare ultrasound-guided IC and AX brachial plexus blocks using the same local anesthetic mixture and volume, with standardized tourniquet application

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and a single experienced operator. The primary objective was to compare the incidence and severity of tourniquet pain between the two approaches. Secondary objectives were to compare tourniquet pain onset time, block performance time, block onset time, block failure, patient and surgeon satisfaction, and adverse events. Based on the proposed advantage of the infraclavicular approach in achieving more proximal blockade, we hypothesized that the incidence of tourniquet pain would be lower following IC-BPB than AX-BPB.

2. Material and methods

Study design and participants

This prospective, parallel-group, superiority randomized controlled trial was conducted at a tertiary care teaching hospital between April 2023 and January 2024. The study began after approval from the Institutional Ethics Committee (BREC/22/TH/Anesth-32, dated 31 January 2023) and was prospectively registered with the Clinical Trials Registry–India (CTRI/2023/03/050667, dated 14 March 2023). Patients aged 18–60 years with American Society of Anesthesiologists (ASA) physical status I–III who were scheduled to undergo orthopedic or plastic surgical procedures distal to the elbow and were expected to require pneumatic tourniquet application for more than 45 minutes were considered eligible for participation. We included 44 patients in the randomized study population. We allocated them to one of two study groups: the infraclavicular brachial plexus block group (IC) or the axillary brachial plexus block group (AX).

Randomization and allocation concealment

Participants were randomly allocated in a 1:1 ratio to the IC or AX group using computer-generated random numbers. A junior anesthesia resident performed randomization. Allocation concealment was maintained using sequentially numbered, opaque, sealed envelopes, which the operating theatre technician opened immediately before administering the block. Blinding of the anaesthesiologist performing the block and the participants was not feasible because the two techniques involve different anatomical approaches and patient positioning. However, a second-year junior anesthesia resident assessed the block and was blinded to group allocation. A single anaesthesiologist experienced in both ultrasound-guided brachial plexus block techniques performed all blocks. The operator had relatively greater experience with the axillary approach.

Ultrasound-guided block technique

After transfer to the operating theatre, we performed a preliminary ultrasound scout scan under strict aseptic precautions using a Sonosite M-Turbo ultrasound machine equipped with a high-frequency (10–13 MHz) linear-array transducer. For each block, we recorded scanning time, needling time, and total block performance time. Total block performance time was defined as the sum of scanning and needling times. For the infraclavicular brachial plexus block, patients were placed supine with the head turned away from the side to be blocked. The elbow was flexed, and the arm was abducted to 90°. After standard skin preparation, the ultrasound transducer was placed in the parasagittal plane to identify the axillary artery, typically visualized at a depth of 3–5 cm. Approximately 1.5–2 mL of local anesthetic was infiltrated into the skin approximately 1 cm lateral to the transducer. The block needle was advanced toward the target using an in-plane, short-axis approach. Following negative aspiration, 1–2 mL of local anesthetic was injected to confirm appropriate needle placement and adequate spread. A total of 24 mL of local anesthetic solution, consisting of 11 mL of 2% lidocaine, 11 mL of 0.5% bupivacaine, and 2 mL of saline, was subsequently deposited posterior

to the axillary artery to achieve a U-shaped distribution around the artery. For the axillary brachial plexus block, patients were positioned supine with the surgical arm abducted and externally rotated at the shoulder. The elbow was flexed and supported on a pillow to facilitate access to the axillary region. Following standard aseptic preparation, 1.5–2 mL of local anesthetic was infiltrated into the skin approximately 1 cm lateral to the ultrasound transducer. The needle was directed toward the target using an in-plane, short-axis technique. All four terminal nerves in the axillary region were selectively blocked using a total of 24 mL of local anesthetic solution: 11 mL of 2% lidocaine, 11 mL of 0.5% bupivacaine, and 2 mL of normal saline.

Assessment of sensory and motor blockade

Sensory block onset was defined as the time at which hypoesthesia appeared in the cutaneous territories of the radial, median, ulnar, and musculocutaneous nerves, as these four terminal nerves determine surgical anesthesia for procedures distal to the elbow. Block assessment was performed at 5, 10, 15, 20, and 30 minutes after needle withdrawal and continued until surgical anesthesia was achieved or for a maximum of 30 minutes. Sensory blockade was assessed using an alcohol swab in six cutaneous nerve territories. Patients rated cold sensation using a three-point scale: 0 indicated no sensation, 1 indicated hypoesthesia, and 2 indicated normal sensation.^[7] Motor blockade was evaluated by assessing elbow extension (radial nerve), flexion of the third finger (median nerve), flexion of the fifth finger (ulnar nerve), elbow flexion (musculocutaneous nerve), and arm abduction (axillary nerve). Motor function was graded on a five-point scale, with 5 representing normal strength, 4 mild weakness, 3 moderate weakness, 2 movement against gravity or minimal contraction, and 1 complete paralysis.^[7] A score of less than 3 in the radial, median, ulnar, and musculocutaneous nerve distributions was considered indicative of motor block onset. Block failure was defined as failure to achieve surgical anesthesia within 30 minutes after administering the block or the presence of pain at the surgical site at any point during the procedure.

Assessment of tourniquet pain and adverse events

Before surgery, a straight pneumatic tourniquet was applied over standard soft padding at the maximum arm circumference, according to the local protocol. If a patient reported discomfort or pain at any time during tourniquet inflation, we recorded the onset time. We assessed tourniquet pain using a visual analog scale (VAS) ranging from 0 to 10. We categorized pain with a VAS score of less than 3 as mild and not requiring intervention. Moderate tourniquet pain was defined as a VAS score of 3–5 and was treated with intravenous fentanyl 2 µg/kg and midazolam 1 mg. Severe tourniquet pain was defined as a VAS score greater than 5 if it was not relieved by fentanyl or if general anesthesia was required. We recorded block-associated adverse events, including vascular puncture, paraesthesia, pneumothorax, and intravascular injection. We assessed patient satisfaction with the immediate perioperative experience and surgeon satisfaction using a Likert scale.

Sample size calculation

We calculated the sample size using the Statistical Package for the Social Sciences (SPSS; IBM Corp., Armonk, NY, USA), version 22. The calculation was based on tourniquet pain severity measured using the VAS and on data reported by Frederiksen et al.,^[8] who reported median tourniquet pain VAS scores of 25 for the axillary approach and 21 for the infraclavicular approach. We estimated the sample size using the Noether method for the Mann–Whitney U test, with a probability-of-superiority parameter (Pn) of 0.84 as

the effect-size parameter. Assuming a two-sided alpha level of 0.05 and 90% power, we estimated a required sample size of 18 patients per group. Assuming an anticipated attrition rate of approximately 20%, we recruited 22 patients per group, for a total randomized sample of 44 patients.

Statistical analysis

We performed statistical analyses using SPSS version 22.0. We compared categorical variables, including gender and ASA physical status, using the Chi-square test. Normally distributed continuous variables, including age, height, weight, BMI, tourniquet pain onset time, and block performance time, were analyzed using the independent Student's t-test. We analyzed non-normally distributed quantitative variables using the Mann–Whitney U test. We considered $P < 0.05$ statistically significant. The primary analysis was performed on a per-protocol basis. When interpreting the results, consider the implications of excluding one participant from the infraclavicular group after primary block failure.

3. Results

Participant flow and baseline characteristics

We assessed 48 patients for eligibility, and all consented to participate. Four patients were excluded because a tourniquet was not used. The remaining 44 participants were randomized equally to the AX and IC groups, with 22 patients allocated to each group. During follow-up, one patient in the IC group experienced primary block failure, defined by the presence of pain at the time of surgical incision, and was excluded from the final per-protocol analysis. Consequently, the final per-protocol analysis included 22 patients in the AX group and 21 patients in the IC group. The two groups had comparable demographic characteristics. The mean age was 30.23 ± 13.46 years in the AX group and 29.45 ± 10.65 years in the IC group ($P = 0.834$). Mean body weight was 68.05 ± 11.44 kg and 62.32 ± 12.59 kg, respectively ($P = 0.122$), while mean height was 170.64 ± 8.66 cm in the AX group and 169.27 ± 7.22 cm in the IC group ($P = 0.574$). Mean BMI was 23.32 ± 3.35 kg/m² in the AX group and 21.65 ± 3.67 kg/m² in the IC group ($P = 0.123$). The sex distribution was also comparable, with 4 females and 18 males in the AX group and 5 females and 17 males in the IC group ($P = 1.000$). In both groups, 17 patients (77.3%) had ASA physical status I and 5 patients (22.7%) had ASA physical status II. (Fig. 1 and Table 1).

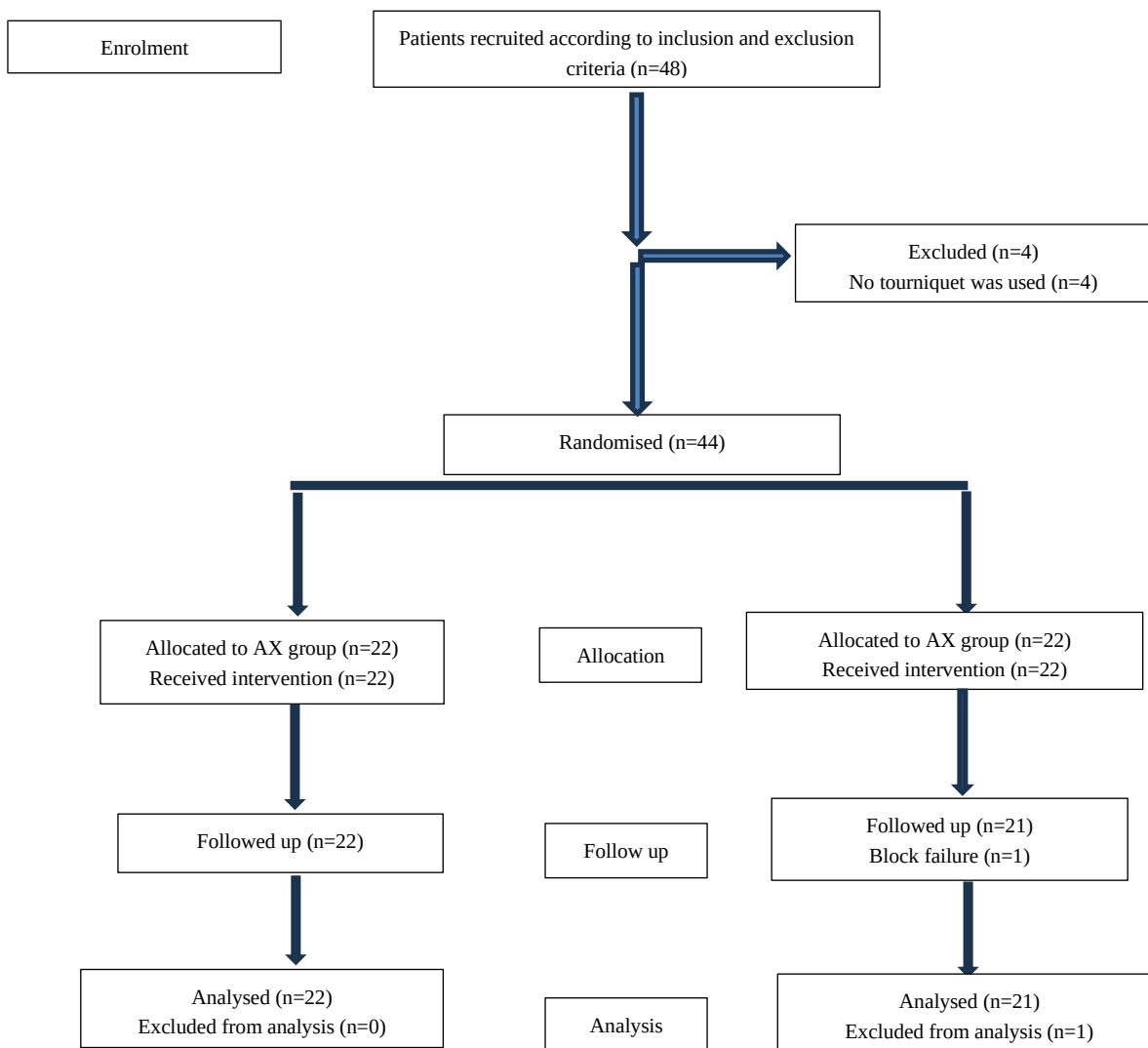


Fig. 1. Consolidated standards of reporting trials (CONSORT) flow diagram of the study. AX= Axillary group; IC= Infraclavicular group.

Table 1. Demographic profiles of the study groups.

Parameter	Group AX (n=22)	Group IC (n=22)	P-value
Age (years);mean(SD)	30.23±13.46	29.45 ±10.65	0.834
Weight (kg); mean(SD)	68.05±11.44	62.32 ±12.59	0.122
Height (cm); mean(SD)	170.64±8.66	169.27±7.22	0.574
Body mass index (Kg/m ²); mean(SD)	23.32 ±3.35	21.65 ±3.67	0.123
Gender (female/male)-n (%)	4(18%)/18(82%)	5(23%)/17(77%)	1.000
ASA Physical status I/II-n (%)	17(77.3%) /5 (22.7%)	17(77.3%) /5 (22.7%)	0.618

Data expressed as mean (SD) or number (percentage). ASA = American Society of Anesthesiologists; SD = standard deviation; n = number of patients.

Block characteristics

The mean scanning time was 45.27 ± 26.52 seconds in the AX group and 32.77 ± 22.03 seconds in the IC group. Although scanning time was shorter in the IC group, the difference was not statistically significant ($P = 0.096$; mean difference 12.5, 95% CI -2.3 to 27.3). Needling time was significantly longer in the IC group than in the AX group (10.97 ± 2.17 minutes vs. 8.88 ± 2.58 minutes; $P = 0.006$; mean difference 2.17, 95% CI 0.642–3.540). Similarly, total block performance time was significantly longer in the IC group than in the AX group (11.43 ± 2.23 vs. 9.54 ± 2.73 minutes; $P = 0.016$; mean difference 1.89, 95% CI 0.366–3.399). The mean sensory block onset

time was 6.82 ± 2.91 minutes in the AX group and 6.59 ± 2.84 minutes in the IC group ($P = 0.794$; mean difference 0.23, 95% CI -1.521 to 1.975). Motor block onset time was 12.95 ± 3.98 minutes in the AX group and 14.32 ± 2.80 minutes in the IC group ($P = 0.196$; mean difference 1.37, 95% CI -0.731 to 3.458). Procedural pain, assessed using the VAS, was also comparable between groups, with mean scores of 2.95 ± 1.00 in the AX group and 2.82 ± 0.90 in the IC group ($P = 0.646$; mean difference 0.13, 95% CI -0.459 to 0.732).

Table 2. Block characteristics of the studied groups.

Parameter	Group AX (n=22)	Group IC (n=22)	P value	Mean Difference (95% CI)
Scanning time (sec); mean (SD)	45.27±26.52)	32.77±22.03	0.096	12.5(-2.3; 27.3)
Needling time (min); mean (SD)	8.88±2.58)	10.97±2.17	0.006	2.17(0.642; 3.540)
Total performance Time(min); mean (SD)	9.54 ±2.73	11.43 ±2.23	0.016	1.89(0.366; 3.399)
Sensory block onset time (min); mean (SD)	6.82 ±2.91	6.59 ±2.84	0.794	0.23(-1.521; 1.975)
Motor block onset time (min); mean (SD)	12.95 ±3.98	14.32 ±2.8	0.196	1.37(-0.731; 3.458)
Procedural pain (VAS* 0-10); mean (SD)	2.95 ±1	2.82±0.9	0.646	0.13(-0.459; 0.732)

VAS = Visual analogue scale (0: no pain; 10: worst pain) Data expressed as mean (SD).). CI= confidence interval; Data were analyzed on a per-protocol basis.

Tourniquet pain

Six patients in the AX group and two in the IC group reported tourniquet pain. The difference in the incidence of tourniquet pain was not statistically significant ($P = 0.240$). The corresponding risk ratio was 0.35 (95% CI 0.08–1.54). Among patients who experienced tourniquet pain, the mean onset time was 58 ± 10.94 minutes in the AX group and 52.5 ± 24.75 minutes in the IC

group. In the AX group, four patients (18%) experienced mild pain, and two patients (9%) experienced moderate pain; no patient experienced severe tourniquet pain. In the IC group, two patients (9.52%) experienced mild tourniquet pain, while no patient experienced moderate or severe pain. The difference in pain severity was not statistically significant ($P = 0.240$).

Table 3. Comparison of tourniquet pain and adverse effects between the two groups.

Parameter	Group AX (n=22)	Group IC (n=21) [#]	P value	Mean Difference (95% CI)
Tourniquet pain onset time (min)	58±10.94 (n=6)	52.5±24.75 (n=2)		
Tourniquet pain Yes/No	6/16	2/19	0.240	RR 0.35 (0.08–1.54)*
Tourniquet pain Mild/moderate/severe	4 (18%)/2 (9%)/0	2 (9.52%)/0/0	0.240	RR 0.35 (0.08–1.54)*
Vascular Puncture Yes/No	1(4.5%)/21 (95.5%)	3(13.6%)/19 (86.4%)	0.607	
Paresthesia Yes/No	5(22.7%)/17 (77.3%)	6 (27.3%)/ 16 (72.7%)	0.728	
Block Failure at 30 min	none	1 (4.55%)		
Patient satisfaction (Likert 0-5)	4.18±0.73	4.33±0.66	0.480	0.15(-0.278; 0.581)
Surgeon's satisfaction (Likert 0-5)	4.73±0.46	4.68±0.72	0.803	0.05(-0.320; 0.411)

Data expressed as mean (SD) or number (percentage). CI = confidence interval; SD = standard deviation; n = number of patients Fisher's exact test. One patient in Group IC was excluded from post-block evaluation due to primary block failure requiring general anesthesia.

Adverse events and satisfaction

Vascular puncture occurred in 1 patient (4.5%) in the AX group and 3 patients (13.6%) in the IC group ($P = 0.607$). Paraesthesia occurred in 5 patients (22.7%) in the AX group and 6 patients (27.3%) in the IC group ($P = 0.728$). No block failure was reported at 30 minutes in the AX group, whereas one patient (4.55%) in the IC group experienced block failure. This patient was subsequently excluded from the post-block per-protocol evaluation because primary block failure required general anesthesia. Patient satisfaction scores were 4.18 ± 0.73 in the AX group and 4.33 ± 0.66 in the IC group ($P = 0.480$; mean difference 0.15, 95% CI -0.278 to 0.581). Surgeon satisfaction scores were 4.73 ± 0.46 and 4.68 ± 0.72 , respectively ($P = 0.803$; mean difference 0.05, 95% CI -0.320 to 0.411). (Fig. 2)

Sensory and motor block characteristics

At 10 minutes, sensory blockade in the distributions of the radial, ulnar, median, medial cutaneous brachial, and musculocutaneous nerves appeared denser in the IC group than in the AX group; however, the between-group differences were not statistically significant ($P > 0.05$). At 15 minutes and thereafter, sensory blockade was similar between the two groups. In contrast, sensory blockade in the distribution of the axillary nerve was denser in the IC group than in the AX group at all assessed time points. Complete loss of sensation was achieved at 10 minutes in the IC group, whereas the AX group showed hypoesthesia at the assessed time points. Between-group differences were statistically significant ($P < 0.05$). Motor blockade of the axillary nerve was also significantly denser in the IC group than in the AX group at all time points after 15 minutes ($P < 0.05$). (Fig. 3).

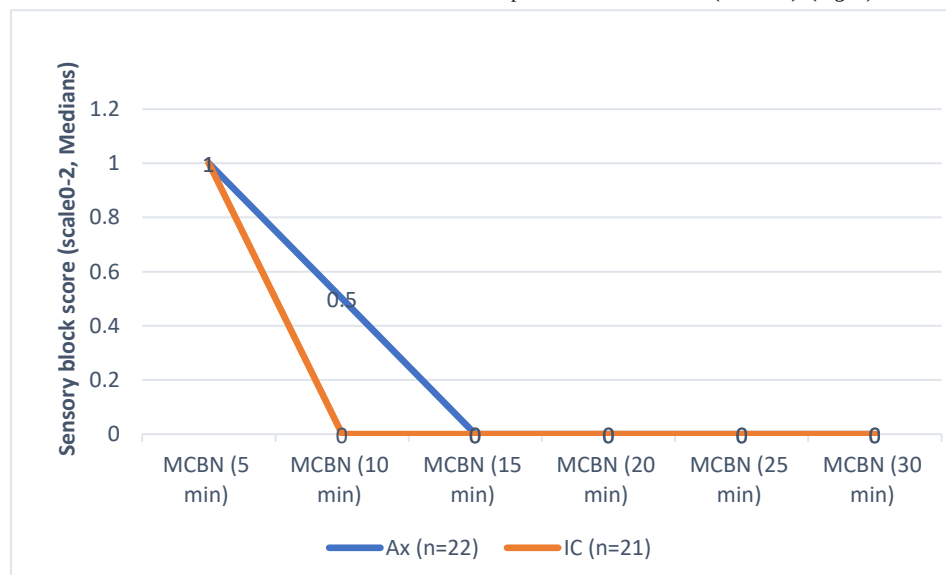


Fig. 2. Trend line chart of sensory block of the medial cutaneous brachial nerve (MCBN) across time points. Data represent median sensory block scores on a 3-point scale (0 = no sensation/complete block, 1 = hypoesthesia, 2 = normal sensation). Sample sizes evaluated per-protocol: Group AX (n=22), Group IC (n=21). We analyzed group comparisons at each time point using the Mann–Whitney U test.

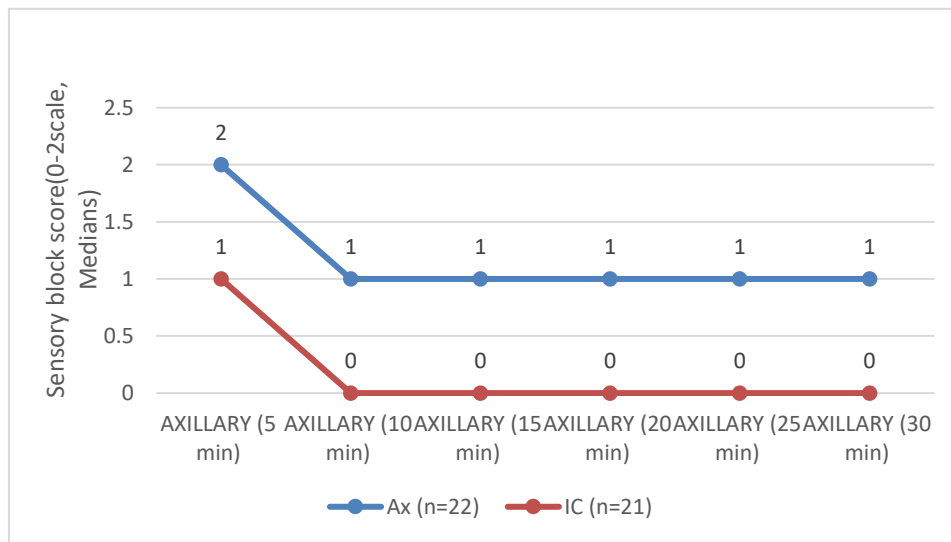


Fig. 3. Trend line chart of sensory block of the axillary nerve across time points. Data represent median sensory block scores on a 3-point scale (0 = no sensation/complete block, 1 = hypoesthesia, 2 = normal sensation). Sample sizes evaluated per-protocol: Group AX (n=22), Group IC (n=21). We evaluated statistical significance between groups using the Mann–Whitney U test at each discrete time interval.

The sensory block in the distribution of the axillary nerve was much denser in the IC group than in the AX group at all time intervals. Complete loss of sensation occurred at 10 min in the IC group, but the AX group showed only hypoesthesia at all time intervals. This difference was statistically significant at all time intervals. ($P < 0.05$) (Figure 3) Grade of motor block for the axillary nerve was also significantly denser in the IC group as compared to the AX group at all time intervals after 15 min. ($P < 0.05$).

4. Discussion

The present randomized controlled trial found no statistically significant difference in the incidence or severity of tourniquet pain between ultrasound-guided axillary and infraclavicular brachial plexus blocks in adults undergoing upper limb surgery distal to the elbow. Tourniquet pain occurred in six patients in the AX group and two patients in the IC group; however, this difference did not reach statistical significance. Tourniquet pain severity was likewise comparable between the two groups. A key finding of the present study was the significantly longer needling time and total block performance time with the infraclavicular approach. In contrast, sensory and motor block onset times did not differ significantly between the two techniques. Patient and surgeon satisfaction, vascular puncture, paraesthesia, and other reported adverse events were also comparable between groups. The findings regarding tourniquet pain are consistent with those reported by Brenner et al.,^[1] who compared infraclavicular and axillary brachial plexus blocks and found no significant differences in the onset, incidence, or severity of tourniquet pain, block onset time, or patient and surgeon satisfaction. However, Brenner et al. reported denser blockade in the axillary and medial cutaneous brachial nerve distributions following infraclavicular block. In the present study, MCBN sensory blockade was comparable between the two groups. One possible explanation for this difference may be the local anesthetic volume used in the two studies. Brenner et al. used a lower volume for the axillary block (15.8 mL) than for the infraclavicular block (24 mL), whereas the present study used the same total volume (24 mL) in both groups. The higher volume administered in the axillary group may have facilitated more proximal spread and contributed to MCBN blockade. However, because the present study did not confirm the extent of local anesthetic spread by

ultrasound, this explanation remains speculative and warrants investigation in future studies. The findings are also consistent with those of Frederiksen et al.,^[8] who reported comparable incidence of tourniquet pain, vascular puncture, paraesthesia, and procedural pain between axillary and infraclavicular approaches. They also reported higher sensory scores with the infraclavicular technique, which was attributed to more effective blockade of the axillary nerve. In the present study, sensory and motor blockade of the axillary nerve was significantly denser in the IC group. In contrast to the present findings, Frederiksen et al.,^[8] reported a shorter block performance time with the infraclavicular approach compared with the axillary approach. Abhinaya et al.,^[9] also reported a shorter performance time with the infraclavicular approach. The longer needling and total performance times observed with the IC technique in the present study may therefore reflect differences in operator experience, institutional practice, or procedural technique. In particular, the single operator in the present study had relatively greater experience with the axillary approach, which may have influenced the observed procedural times. Consequently, interpret differences in block performance time cautiously; they do not necessarily reflect an inherent characteristic of the two techniques. Sebastian et al.,^[10] in a study of tourniquet pain following ultrasound-guided axillary blockade, reported tourniquet pain in only one of 84 patients, suggesting that an ultrasound-guided axillary approach may also provide effective control of tourniquet-related pain. These findings similarly show that tourniquet pain was relatively uncommon in both groups. Multiple factors influence tourniquet-related pain. In addition to neural blockade, mechanical factors such as tourniquet width, shape, inflation pressure, and inflation duration may affect the occurrence and severity of pain.^[10, 11] The quality and density of the brachial plexus block may also influence the patient's perception of tourniquet pain. In the present study, using the same local anesthetic mixture and volume in both groups provided standardization that may have contributed to the comparable incidence of tourniquet pain. However, the results should be interpreted in light of several limitations. First, this single-center study had a relatively small sample size, which may limit the generalizability of the findings. Second, the overall incidence of tourniquet pain was low, with only eight patients experiencing the primary outcome across both groups. This small number of events substantially limits statistical power to compare tourniquet pain incidence,

severity, and onset time, as reflected in the relatively wide confidence interval around the reported risk ratio. Third, we excluded one participant in the IC group from the final per-protocol analysis because of primary block failure. This post-randomization exclusion may introduce attrition bias. Fourth, although the outcome assessor was blinded, the anesthesiologist performing the block could not be blinded to the technique, creating the possibility of performance bias. Fifth, a single experienced anesthesiologist performed all blocks and had greater experience with the axillary approach. This difference in operator familiarity may have contributed to the longer needling and total performance times observed with the infraclavicular technique and may limit the generalizability of this finding. Finally, the present trial was designed and powered as a superiority study. Therefore, the absence of a statistically significant difference between the two techniques should not be interpreted as demonstrating statistical equivalence or non-inferiority. Rather, the findings indicate that the present sample showed no statistically significant difference. Overall, the present findings suggest that both ultrasound-guided axillary and infraclavicular brachial plexus blocks were associated with a low observed incidence of tourniquet pain, with no statistically significant difference between the groups. The infraclavicular approach was associated with longer needling and total block performance times, whereas block onset, satisfaction, and the reported adverse events were broadly comparable. Larger, adequately powered, multicenter randomized trials are needed to obtain more precise estimates of the comparative effects of the two approaches, particularly regarding tourniquet pain incidence and severity.

5. Conclusion

In this randomized study, we found no statistically significant difference in the incidence or severity of tourniquet pain between ultrasound-guided axillary and infraclavicular brachial plexus blocks for upper limb surgery. The infraclavicular approach was associated with significantly longer needling and total block performance times. In contrast, other measured outcomes, including block onset time, adverse events, and patient and surgeon satisfaction, were comparable between the groups. Given our limited sample size and the wide confidence intervals around the primary outcome estimates, adequately powered, multi-center trials are required to determine whether the two approaches provide comparable efficacy for tourniquet pain management.

Conflict of Interest

The authors declared that there is no conflict of interest.

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